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ABSTRACT

This curriculum guide provides instructional objectives and activities for teaching science in grades 7-9. The objectives are stated in behavioral or performance terms and have been arranged in increasing levels of complexity according to Bloom's Taxonomy. The behavioral objectives generally include two major components: (1) the objective statement which specifies the intended behavior of the students as a result of having participated in a set of instructional experiences, and (2) activities which outline what the student should do to attain the objective. It is stressed that the suggested objectives and activities should not be seen as limiting teacher innovation or what the student is expected to know; rather, they should be added to, deleted, or modified by the teacher according to the needs and characteristics of individual students and the teacher's own experience and knowledge. This work was prepared under an ESEA Title III contract. (Author/JR)

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Secondary Schools

CURRICULUM

GUIDE

Cranston School Department
Cranston, Rhode Island
1972

SCIENCE

Grades 7-9 **Levels 1-15**

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Secondary School

CURRICULUM GUIDE

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Prepared By

a curriculum writing team

of secondary teachers

Project PACESETTER

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Cranston School Department

845 Park Avenue

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1972

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PREFACE

The following levels consist of instructional objectives and activities for each course of study within every curriculum area. These materials were produced by a staff of teachers working on curriculum teams for Project PACESETTER. They are, therefore, the product of the experience of the professionals who will put them to use.

This curriculum guide provides each teacher with curriculum materials organized into behavioral objectives with a scope and sequence. The guide is intended to encourage feedback so that a fully classroom tested curriculum will eventually result from the participation and suggestions of all teachers in the secondary schools of Cranston.

OBJECTIVES IN TERMS OF LEARNING VARIABLES

Bloom and his collegues devised a taxonomy of educational objectives designed to classify the behavior of students in three domains as a result of having participated in a series of instructional experiences. The three domains are the cognitive (intellectual), the affective (emotional), and the psychomotor (physical). Within each of these domains there is a hierarchy which denotes increasing complexity of learning which is shown below.

Cognitive	Affective	Psychomotor
knowledge	receiving	frequency
comprehension	responding	energy
application	valuing	duration
analysis	organization	
synthesis	characterization	
evaluation		

The objectives which appear in these Curriculum guides have been stated in behavioral or performance terms. In addition to the general technique of the behavioral statement, the authors were careful to differentiate the levels at which given behaviors could be expected of the student. Thus, in the cognitive domain, a student's performance in the display of knowledge of a concept is less complex than the student's performance when he applies the concept in a given situation. Similarly, in the affective domain, a response to a situation is not as complex as the display of a value toward a given situation.

In initial classroom trials of this curriculum teachers will evaluate the appropriateness of the objectives and make recommendations for revising, deleting, or adding to the objectives or activities.

LEVELS, OBJECTIVES, AND ACTIVITIES

The curriculum guides provided here are organized into behavioral objectives which generally include two major components. The first is the objective statement which specifies the behavioral variable--the intended behavior of the students as a result of having participated in a set of instructional experiences, the content or topic and the evaluative criterion which is sometimes implicit in the behavioral objective. Curriculum writers have made every effort to classify the intended behaviors in keeping with the work of Bloom and others. The objectives, then, are stated in terms of specific behaviors which range from the simple, such as memorizing or translating, to the most complex, such as synthesizing or evaluating. The second major component is comprised of activities which outline what the student should do to attain the objective. These activities are suggested and should be added to, deleted, or modified by the teacher according to the needs and characteristics of individual students and the teacher's own experience and knowledge.

It is important to note here that the objectives serve the purpose of helping each teacher select appropriate learning experiences, communicate to others what is expected, and provide both student and teacher with a standard for evaluating progress. Objectives should not be seen as limiting teacher innovation or what the student is expected to know.

Each of the curriculum areas is divided into major topics or "Levels." Each level begins with a level objective which is followed by numbered objectives subordinate to it. Suggested activities follow each of these specific objectives and are numbered consecutively throughout the level.

EVALUATIVE CRITERIA

Many of the evaluative statements included in the behavioral objectives are teacher oriented; final decisions on evaluation have traditionally been the prerogative of the teacher. As we move toward continuous progress and, eventually, individualized instruction, it is hoped that the evaluation component increasingly becomes the shared responsibility of both teacher and student.

TABLE OF CONTENTS

SCIENCE

Grades 7-9

Title	Level*	Suggested Grade
The Biosphere: Microscopy, Cells and Photosynthesis	SC 1	7
The Biosphere: Digestion, Transporation, Energy- Relations in Metabolism	SC 2	7
The Biosphere: Coordination, Reproductive Patterns and Taxonomy	SC 3	7
The Biosphere: Genetics, Ecology, and Evolution	SC 4	7
Matter and Energy: The Structure and Properties of Matter	SC 5	7
Matter and Energy: The Classification of Matter	SC 6	7
Matter and Energy: Matter: Measurement and Motion	SC 7	7
Matter and Energy: Heat, Light, and Energy Conversion	SC 8	7
Earth Science: Force and Energy	SC 9	8
Earth Science: Weather and climate	SC 10	8

* pages are numbered within levels only

Title	Level*	Suggested Grade
The Physical Earth: The Land	SC 11a	8
The Physical Earth: The Sea	SC 11b	8
Earth Science: The Earth in the Universe	SC 12	8
Physical Science: Measuring Matter	SC 13	9
Physical Science: Characteristic Properties	SC 14	9
Physical Science: Separating Substances	SC 15	9
Physical Science: Building an Atomic Model of Matter	SC 16	9

* pages are numbered within levels only

LEVEL OBJECTIVE:

THE STUDENT WILL DEMONSTRATE APPLICATION OF MICROSCOPIC TECHNIQUES IN BIOLOGICAL INVESTIGATION. IN ADDITION, HE WILL DEMONSTRATE COMPREHENSION OF THE STRUCTURAL AND FUNCTIONAL UNIT OF LIFE AND THE PHOTOSYNTHETIC PROCESS BY COMPLETING THE FOLLOWING SUGGESTED ACTIVITIES.

I. Microscope and Lab Practice

Objective #1: The student will demonstrate application of basic laboratory techniques used in biological microscopy by completing the following suggested activities to be evaluated by teacher observation and/ or tests.

Activities:

1. Set up a laboratory investigation in written form in order to identify materials, experimental procedures, results, and interpretations.

2. Name and identify the high and low power objectives, fine and coarse adjustments, body tube, stage clips, diaphragm, mirror, revolving nosepiece, stage, arm, and eyepiece of a microscope.

3. Explain the function of the high and low power objectives, fine and coarse adjustments, diaphragm, mirror, and revolving nosepiece of a microscope.

4. Focus the microscope on wet mount slides and prepared slides.

5. Prepare a wet mount slide from a hay infusion.

6. Determine the volume of liquids in milliliters by using a graduate cylinder.

7. Determine the mass of a substance in grams by using the triple beam balance.

8. Identify the basic metric system units --- gram, liter, and meter.

II. Ivestigating Life

Objective #2: The student will demonstrate comprehension of the nature of life in terms of the structure and function of its basic unit by performing the following activities to be evaluated by teacher observation and/ or tests.

Activities:

9. Describe the "characteristics of life" --- locomotion, reproduction, food getting, digestion, respiration, excretion, growth, and circulation.

10. Determine if brown sugar, yeast, sand and radish seeds are living or non-living.

11. List and identify the major parts (centrosome, cytoplasm, vacuole, nuclear membrane, nucleolus, nucleus, chromatin, cell membrane) of an animal cell.

12. List and identify the major parts (chloroplasts, cytoplasm, vacuole, nucleus membrane, nucleolus, nucleus, chromatin, cell membrane, cell wall) of a plant cell.

13. List the similar structures (cell membrane, nucleus, nuclear membrane, nucleolus, chromatin, vacuoles) of both animal and plant cells.

14. List the different structures (centrosome, chooroplasts, cell wall) of both animal and plant cells.

15. Relate cell structures (cell wall, cell membrane, nucleus, nuclear membrane, nucleolus, chromatin, centrosome, chloroplasts, vacuoles, cytoplasm) to their functions.

16. Define protozoan.

17. List examples of protozoans.

18. Identify protozoa by classification based on movement.

19. Diagram an amoeba (ameba) including the following parts --- food vacuoles, pseudopodia, ectoplasm, endoplasm, nucleus, contractile vacuole.

20. Describe and identify the following structures of an amoeba: food vacuoles, pseudopodia, ectoplasm, endoplasm, nucleus, contractile vacuole.

21. Relate the amoeba's structures to their functions.

22. Locate in a liquid culture the amoeba by using a microscope.

23. Identify the structures (mouth, gullet, food vauoles, anal spot, contractile vacuole, endoplasm, ectoplasm, cilia, pellicle, trichocysts) of a paramecium by using a biological diagram.

24. Relate the paramecium's structures to their functions.

25. Compare and contrast the structures and "characteristics of life" of an amoeba and a paramecium.

26. Identify the euglena from a mixed culture of protozoans.

27. Describe and identify the following structures of the euglena: mouth, gullet reservoir, eyespot, contractile vacuole, nucleus, chloroplasts, pyrenoids, flagellum.

28. State and explain the "Cell Theory."

29. Give reasons that support the "Cell Theory."

30. Organize a sequence of tests to determine if something shows signs of life based upon observations of movement, growth, food getting, reproduction, and respiration.

31. Match and locate microorganisms in a mini-biosphere (grass-water culture) by using a key.

32. Prepare and examine wet mount slides of various water samples by using the microscope.

33. Consider overpopulation, pollution, and depletion of natural resources as ways in which man is destroying his population.

34. Explain how the factors pH, temperature, food supply, and pollutents affect the numbers and types of protozoans.

III. Interactions

Objective #3: The student will demonstrate comprehension of the photosynthetic process and its fundamental role in the world of life by performing the following activities to be evaluated by teacher observation and/or tests.

Activities:

35. Observe the interaction between green plants and their environment by performing experiments dealing with the process of photosynthesis.

36. Derive an equation for photosynthesis that is based upon the student's own observations and experiments.

37. Verify the importance of light in food production of plants.

38. Illustrate the exclusion of one variable (light, chlorophyll, carbon dioxide, and water) in the photosynthesis reaction.

39. Set up a water bath.

40. Identify a positive test for starch using the indicator IKI.

41. Identify a positive tests for sugar using the indicator Benedict's Solution.

42. Conduct a starch test on unknowns by using IKI.

43. conduct a sugar test on unknowns by using Benedict's Solution.

44. Relate starch content in leaves to food production.

45. Set up an experiment to test the effect of the removal of carbon dioxide from the atmosphere of a plant by using sodium hydroxide pellets.

46. Set up an experiment using the coleus plant that demonstrates the importance of chlorophyll in the photosynthetic process.

47. Observe the relationship between chlorophyll location and starch production in a geranium leaf.

48. Prove by experimenting with elodea that oxygen is produced by green plants during photosynthesis.

49. Trace the role of water in the photosynthetic reaction.

50. Explain the role of water, light, carbon dioxide, chlorophyll, and oxygen in relation to photosynthesis.

51. Describe the relationship between plant photosynthesis and animal respiration.

52. Observe different cells such as blood, skin, onion, and lettuce.

53. Diagram the carbon dioxide-oxygen cycle which exists between plants and animals.

54. Read bar and line graphs.

55. Construct a bar and line graph including labels of both axes.

56. Plot a graph for rainfall in inches and temperature in degrees centigrade.

57. Interpret a temperature-rainfall graph.

58. Relate graphs of temperature and rainfall to photos of different areas of vegetation

LEVEL OBJECTIVE:

THE STUDENT WILL DEMONSTRATE COMPREHENSION OF THE BASIC LIFE FUNCTIONS OF DIGESTION AND TRANSPORTATION AND ENERGY RELATIONS IN METABOLISM BY COMPLETING THE FOLLOWING SUGGESTED ACTIVITIES.

I. Digestion

Objective #1: The student will demonstrate comprhension of the life function of digestion by completing the following activities to be evaluated by teacher observation and/or tests.

Activities:

1. Dissect a frog and indicate the major parts of the digestive system.

2. Observe the anatomy of a frog's digestive system using a diagram to locate the following structures: mouth, vomerine teeth, tongue, esophagus, liver, gall bladder, stomach, small intestine, pancreas, mesentery, spleen, large intestine, urinary bladder, cloacal opening.

3. Identify and locate the hilum, micropyle, plumule, hypocotyl, cotyledons, and testa on a bean seed.

4. Identify and test for sugar by using tetrazolium.

5. Indicate the location of sugar in seeds by performing the tetrazolium tests.

6. Suggest where the starch-changing substance comes from in a bean seed by testing its effect on a card which has been soaked in KI (potassium iodine solution).

7. Observe teh substance produced by soaked seeds that is capable of bleaching KI.

8. Design an experiment to test the effect of saliva on starch be testing for the presence of simple sugars.

9. Describe the functions of enzymes including the ability to speed up a reaction and conditions (pH, temperature, concentration) needed for its function.

10. Define the term "biological converter."

11. Investigate the prblem of environmental temperature and digestion by using starch and saliva.

12. Classify foods into three groups --- carbohydrates, proteins, and fats.

13. Identify foods that are carbohydrates, proteins, and fats.

14. Prepare a mett's tube containing egg white for protein testsing.

15. Compare protein digestion in dilute HCl (hydrochloric acid), pepsin solution, and pepsin-HCl mixture.

16. Identify a substance as either an acid, base, or salt by using such indicators as red and blue litmus paper, methyl orange, phenolphtalein and bromthymol blue.

17. Describe whether a substance is an acid, base, or salt in terms of pH.

18. Determine the pH of various substances by using pH paper.

19. Perform an experiment to investigate the effect of pH on the action of pepsin in protein digestion.

20. Explain how the digestion of proteins and fats take place in the small intestine.

21. Describe how cells obtain food by the process of diffusion and osmosis.

22. Discover the diffusion of sugar by using a sugar solution and dialysis tubing.

23. Discover the role of surface area in absorption by varying the length of dialysis tubing.

24. Locate and identify on a diagram the major structures (hard and soft palate, mouth cavity, tongue, teeth, pharynx, epiglottis, esophagus, stomach, spleen pancreas, gall bladder, liver, duodenum, small and large intestine, colon, rectum, appendix) of the human digestive system.

25. Explain the functions of the major organs in the human digestive system.

26. Explain the relationship of the secretions of the major glands (pancreas, liver, gastric, intestinal) to digestion.

II. <u>Transport Systems</u>

Objective #2: The student will demonstrate comprehension of the life function of transportation in animals and plants by completing the following activities to be evaluated by teacher observation and/or tests.

Activities:

27. Locate and measure the radial pulse of a human.

28. Describe the perfromance of the heart by determining the pulse rate when resting, walking, and running.

29. Explain how the factors -- height, weight, sex, and physical condition -- affect pulse rate.

30. Trace the path of blood as it would normally leave the heart of a frog on a diagram.

31. Compare and contrast the circulatroy system of a frog and man by using charts of a frog and a man.

32. Describe the pathway of blood circulation in man by including the following terms: veins, arteries, capillaries, heart, lungs, auricle, ventricle.

33. Identify the parts of the heart (right and left auricles, right and left ventricles, valves) on a model of a heart.

34. Identify the arteries, veins, and capillaries on a chart of the human circulatory system.

35. Compare and contrast the structure and function of the arteries, veins, and capillaries.

36. Explain how the circulatory system removes the products of digestion.

37. Justify that food molecules are transported by the circulatory system to various cells where they are used for energy and growth.

38. Explain how food and waste products are transported in animal and plant circulation.

39. Observe the growth of a young root using radishes, beans, and peas.

40. Determine how the root's structure is related to the function of water absorption.

41. Identify the specialized zones in a longitudinal diagram of a root including those of the root cap, meristem, elongation, and maturation.

42. State the functions of each zone of a root.

43. Define and contrast monocot and dicot seedlings.

44. Define and locate the structures (epidermis, cortex, endodermis, xylem, phleom, parenchyma, pericycle, root hairs) by using a prepared diagram of a monocot and dicot cross-section.

45. Observe and locate root structures on a prepared slide of a monocot and dicot root cross-section.

46. State the function of each structure (epidermis, cortex, endodermis, pericycle, parenchyma, xylem, phloem, root hairs) in a root cross-section.

47. Construct a model of a root-transport system using paper toweling and glass tubing.

48. Design an experiment investigating the function of the stem by using a celery stalk and colored water.

49. Locate the vascular bundles in a celery stalk by using vegetable dye.

50. Demonstrate the effect of salt solution on water transportation in a stem.

51. Define and locate the following structures in a monocot and dicot stem: epidermis (dicot), rind (monocot), cortex, phloem, cambium (dicot), xylem, pith.

52. Compare and contrast structures in the cross-section of a monocot and dicot stem using prepared microscope slides.

53. Describe the function of the stem structures in a monocot and dicot stem.

54. Investigate th capillary action of a stem by using capillary tubes and colored water.

55. Determine the age of woody plants by counting the growth rings.

56. Observe the external structures (filbrovascular bundles, lenticels, bud scale scars, leaf scars, bud scales, terminal bud) of a woody stem.

57. Identify the upper and lower epidermis, palisade and spongy layers, chloroplasts, vein, stoma, guard cell in a diagram of a leaf cross-section.

58. Relate leaf structures to their functions.

59. Investigate the relationship that exists between the surface area of a leaf and the loss of water by designing an experiment using paper toweling and glass tubing.

60. Summarize transport in a plant by including the movement of materials through roots, stems and leaves.

III. Energy Relations in Metabolism (Optional)

Objective #3: The student will demonstrate comprehension of the energy relations in metabolism through calorimetric measurement by performing the following activities to be evaluated by teacher observation and/or tests.

Activities:

61. Explain the utilization of food particles within cells.

62. Define the term calorie.

63. Calculate the number of calories required to cause a temperature change of various amounts of water.

64. Determine the calories the amount of heat produced when a food material is burned by using a calorimeter.

65. Construct a calorimeter given the necessary materials.

66. Determine the number of calories contained in solid foods.

67. Calculate the number of calories per gram of food burned.

68. Distinguish between a calorie, Calorie, and Kilocalorie.
D
69. Determine the amount of energy used on an activity in relation to weight and time by referring to a calorie chart.

70. Calculate the number of kilocalories per kilogram per hour for various activities.

71. Explain that sugar is further broken down in the cell in a series of chemical changes known as cellular respiration.

72. Compare cellular respiration of food with the burining of a candle by measuring the release of water and carbon dioxide.

73. Discuss the balance in nature between plants and animals in relation to photosynthesis and respiration.

LEVEL OBJECTIVE:

THE STUDENT WILL DEMONSTRATE COMPREHENSION OF COORDINATING SYSTEMS, PATTERNS OF REPRODUCTION, AND TAXONOMY BY COMPLETING THE FOLLOWING SUGGESTED ACTIVITIES.

I. Coordination

Objective #1: The student will demonstrate comprehension of how coordination is accomplished in living organisms by performing the following suggested activities to be evaluated by teacher observation and/or tests.

Activities:

1. Identify the locations and functions of the major parts of the central nervous system: 1. the brain (cerebrum, cerebellum, and medulla) and 2. the spinal cord.

2. Describe the pathway of a reflex arc, include: sensery, motor, connective nerves, stimulus, and response.

3. Demonstrate the response of the pupil to light intensity and explain the terms dilate and constrict.

4. Demonstrate the reaction time to catching a folded paper between thumb and forefinger.

5. Describe the function of nerve receptors in the skin (pain, pressure, and temperature) and conduct a simple experiment to locate pressure receptors.

6. Demonstrate the sensation of temperatures to the skin when the threshold level is exceeded.

7. Locate on a chart or model of the eye, and identify the functions of: cornea, iris, pupil, lens, retina, and optic nerve.

8. Explain the differences and causes of nearsightness, far-sightness, astigmatism and color-blindness.

9. Demonstrate and explain the blind spot of vision.

10. Demonstrate and explain the appearance of afterimages.

11. Locate on a chart or model of the ear, and explain the functions of: the outer ear, typanum, hammer, anvil, stirrup, cochlea, Eustachian tube, and auditory nerve.

12. Demonstrate the effects of rotation of the body on the semicircular canals and balance.

13. Explain the difference between the frequency and the loudness of a sound.

14. Distinguish between odors and taste, and locate of the tongue the regions for sweet, sour, salty, and bitter.

15. Explain how the body maintains an internal balance of: cellular fluids, sugar, and urea.

16. Compare the functions and organs involved in excretion, secretion, and elimination.

17. Describe the exchange and control of oxygen and carbon dioxide gases.

18. Explain how air pollution, smoking, diseases, and carbon monoxide effect respiration.

19. Locate on a chart of diagram and describe the functions of the following glands:

gland	function
1. pituitary	growth, master gland
2. thyroid	growth, metabolism
3. adrenals	stress
4. reproductive (ovaries, testes)	secondary sexual characteristics

20. Describe tropisms, (gravity, light, and water), and importance of auxins in plant coordination

21. Recognize how the maintance of heart beat, body temperature, and respiration are coordinated by both the nervous system and endocrine glands.

II. Reproductive Patterns

Objective #2: The student will demonstrate comprehension of basic patterns of reproduction in animals by performing the following activities to be evaluated by teacher observation and/or tests.

Activities:

22. Expalin why the survival of a species depends upon its rate of reproduction.

23. Describe how man's activities have endangered or caused the extinction of certain animals.

24. Explain how nature controls overpopulation in a species.

25. Describe the mechanism of cell division identifying: nucleus and chromosomes.

26. Recognize and give examples of how a sexual reproduction occurs in plants and animals.

27. Identify on a diagram the male reproductive organs including: penis, testes, and scrotum.

28. Identify on a diagram the female reproductive organs including: vagina, oviducts (Fallopian tubes), ovaries, and uterus.

29. Identify and describe the formation of gametes (sperm and eggs).

30. Describe and give examples of external fertilization in water-dwelling animals.

31. Explain the importance of a fluid environment for internal fertilization.

32. Describe the incubation of eggs by birds and reptiles.

33. Describe the sequence of events in the development of a mammal, include: internal fertilizai-on, implanting of zygote, nourishment and protection of the embryo.

34. Identify on a diagram of an unborn child, the following : fetus, placenta, umbilcal cord, amnionic fluid.

35. Explain the importance of recombination of chromosomes in fertilization.

36. Demonstrate a sexual reproduction in potatoes or yeast.

37. Identify on a chart or model the events of sexual reproduction in plants, include: pollen tubes, sperms, ovules, and fertilization.

38. Observe sperm cells from a frog.

39. Describe how reproduction can be used to control insect populations.

III. Taxonomy

Objective #3: The student will demonstrate comprehension of taxonomic principles by performing the following activities to be evaluated by teacher observation and/or tests.

Activities:

40. Define taxonomy and give reasons for classifying and organizing living things.

41. Describe the problems that occur in the use of common names for organisms.

42. Define and identify the proper form of a scientific name.

43. Use Latin or Greek descriptive terms to construct species or generic names of organisms.

44. Construct a classification system based upon the structual characteristics of mythical organisms.

45. Give reasons for the following divisions of classification: Kingdom, Phylum, Class, Order, Genus, and species.

46. Use an identification key to find the names of organisms.

LEVEL OBJECTIVE:

THE STUDENT WILL DEMONSTRATE COMPREHENSION OF ECOLOGICAL RELATIONSHIPS AMONG LIVING THINGS AND BASIC PRINCIPLES OF GENETICS AND EVOLUTION BY COMPLETING THE FOLLOWING SUGGESTED ACTIVITIES.

I. Heredity

Objective #1: The student will demonstrate comprehension of the basic hereditary mechanisms which insure genetic continutiy by performing the following suggested activities to be evaluated by teacher observation and/or tests.

Activities:

1. Give examples of how physical traits are transmitted from parent to offspring.
2. Identify characteristics that lead to similarities and differences in the appearance of individuals.
3. Conduct an experiment to show variability in eye color among classmates.
4. Conduct an experiment to show the symmetrical distribution of height or weight around an average value.
5. Determine the average value from data on height or weight of classmates.
6. Identify the median on a distribution graph.
7. Give examples of how offspring resemble parents.
8. Explain the study of inheritance helps man.
9. Define the terms: genetics, chromosome, gene, and allele.
10. Explain why all inheritance is passed on to the offspring through information contained in the gametes.
11. Recognize chromosomes from pictures or microscopic slides.
12. Give examples of how different species have different numbers of chromosomes.
13. Explain how heredity is controlled or influenced by genes.
14. Give examples of how a gene has different forms or alleles.

15. Identify the symbols; male (sperm) and female (egg).

16. Construct a model to show how the sperm and egg carry the inherited genes.

17. Explain why the gametes have only one-half the number of chromosomes.

18. Construct a model with colored pipe cleaners to show how different combinations of genes can occur in the offspring.

19. Explain how the laws of chance and probability determine the allelic combinations.

20. Conduct an experiment to show the probability of two independent events occuring together by the flipping of two different coins.

21. Explain and write the combinations of pure and hybrid alleles for blue and brown eyes.

22. Construct a genetic checkerboard to determine eye colors of offspring that result from a cross between pure blue and brown eyed parents.

23. Distinguish between a dominant and a recessive allele.

24. Construct a genetic checkerboard to determine eye colors that result from a cross between hybrid brown eyed parents.

25. Identify the traits: hair color, eye color, shape of earlobe, tongue curling, PTC tasting, incisor teeth, and eye shape, and distinguish between dominant and recessive inheritance.

26. Identify dominant and recessive alleles in man.

27. Identify dominant and recessive alleles in corn and peas.

28. Explain why a cross between hybrid parents results in a 3:1 ratio, dominant to recessive, in the offspring.

29. Determine the gametes that occur from two pairs of alleles.

30. Construct a genetic checkerboard to show the offspring that result from a two-allele cross.

31. Explain the ratio 9:3:3:1 that results from a two-allele cross.

32. Set up a model using colored chips to determine the combinations of alleles that result from a two-allele cross by chance.

33. Determine on an ear of genetic corn the actual ratios that resulted from a two-allele cross.

34. Explain how the X and Y chromosomes determine sex in man.

35. Construct a genetic checkerboard to show how the human sperm cell determines the sex of the offspring.

36. Explain how hemophilia and color-blindness are sex-linked diseases.

37. Give examples of how mutations result in new alleles.

II. Ecology

Objective #2: The student will demonstrate comprehension of basic ecological principles by performing the following activities to be evaluated by teacher observation and/or tests.

Activities:

38. Define and give examples of natural populations.

39. Make a population census.

40. Define a changing population using the terms: birth, death, and dispersal.

41. Describe the carrying capacity of an environment.

42. Describe the influence of biotic potential and environmental resistance on population size.

43. Give examples of cooperation and competition in natural populations.

44. Determine the area of an acre.

45. Explain how animals establish territories.

46. Describe a food chain for an aquatic and a land evnironment.

47. Describe the nutrition of the following classes of organisms:

    a. producers
    b. primary consumers
    c. secondary consumers
    d. scavengers

48. Explain the nutrition of the following consumers: herbivore, carnivore, and ominvore.

49. Match a group of organisms with their physical surroundings.

50. Draw a food web showing the relationship among producers, consumers, and scavengers.

51. Describe an animal's interaction with its ecosystem.

52. Identify ten large natural ecosystems.

53. Describe an ecosystem in terms of its rainfall, annual temperature and prevailing vegetation.

54. Match animals with natural ecosystems.

55. Explain how dispersal of plants occurs through wind, water, and insects.

56. Explain how dispersal of animals occurs through competition.

57. Explain how biological clocks have an effect on an animal's behavior.

58. Describe the changing ecosystem in a pond and a land succession.

59. Demonstrate the succession on a microscope slide.

III. Evolution

Objective #3: The student will demonstrate comprehension of the nature and mechanisms of evolutionary change by performing the following activities to be evaluated by teacher observation and/or tests.

Activities:

60. Explain and give examples of how fossils are preserved.

61. Identify the types of rocks in which fossils occur.

62. Explain how the evolution of organisms is shown by fossils.

63. Relate the fossils that appear in a rock layer to the relative age and the climate in which they were formed.

64. Identify on a drawing of a section of canyon wall the oldest and youngest layers.

65. Identify the methods by which fossils were formed in a rock layer.

66. Explain how the breeding of horses can result in new types by selection.

67. Compare the modern horse to extinct species.

68. Explain why natural selection is the main force of evolution.

69. Conduct an experiment to show how random selection will affect a large population of dark and light insects.

70. Conduct an experiment to show how non-random selection will change a population of insects.

71. Explain how variation, selection, and mutation operate in evolution.

LEVEL OBJECTIVE:

THE STUDENT WILL DEMONSTRATE COMPREHENSION OF THE NATURE OF MATTER IN TERMS OF ITS PROPERTIES AND STRUCTURE BY COMPLETING THE FOLLOWING SUGGESTED ACTIVITIES.

I. Investigating Matter

Objective #1: The student will demonstrate comprehension of the nature of matter in terms of its properties by performing the following suggested activities to evaluated by teacher observation and/or tests.

Activities:

1. Carry out investigations, identify materials, make observations, record results, and draw conclusion from observations.
2. Provide information that may be useful in making a rough estimate of the size of atoms or molecules.
3. Calculate the thickness of the film formed by a soap droplet.
4. Identify errors that might be involved in calculating the volume of a soap droplet and soap film and what the consequences of these errors might be.
5. Observe Brownian motion by using a microscope and a homogenized milk suspension.
6. Investigate the behavior of water particles by observing bubbles, drops and films.
7. Gather information related to surface tension by studying bubbles and film.
8. Recognize the abbreviations for Celsius (centigrade) and Fahrenheit temperature scales.
9. Perform temperature-conversions by using the conversion formulas: $^{o}F=9/5 = 32$ $^{o}C=5/9 (F-32)$
10. Recognize the relation of the Centigrade scale to the Fahrenheit scale.
11. Take temperatures of various materials by using a Centigrade thermometer and a Fahrenheit thermometer.

12. Separate components of matter (chromatography) by using green food coloring, water (solvent), and a strip of filter paper.

13. Design an experiment illustrating chromatography using different kinds of paper, solvents, and materials to be separated.

II. The Structure of Matter

Objective #2: The student will demonstrate comprehension of the atomic model of matter by performing the following suggested activities to be evaluated by teacher observation and/or tests.

Activities:

14. Develop his own classification scheme of elements by using photographs and data on the appearance of some elements.

15. Define each of the terms: element, compound, atom, and molecule.

16. Observe an experiment related to electrostatic charge that demonstrates positive and negative charges, attraction, and repulsion.

17. Observe the effects of electrical charges by performing an experiment using plastic rulers, wool, and plastic wrap.

18. Formulate a hypothesis that atoms contain electrical charged particles

19. Describe the work of Ernest Rutherford.

20. Describe the properties of a proton, electron, and neutron.

21. Distinguish between the three sub-atomic particles---electron, proton, neutron.

22. Define the terms atomic weight and atomic number.

23. Define the term ionization energy.

24. Suggest that ionization energy plays a key role in grouping the electrons for any element.

25. Identify the energy levels K, L, M, N, O, P, Q, of an element and the number of electrons each level can hold.

26. Prove that the basis for grouping elements into families and for grouping these families in the Periodic Table is the number of electrons in the outermost shell of the elements atom.

27. Identify an element by the number of protons in an atom of that element.

28. Define isotope.

29. Differentiate between an atom and its isotope.

30. Describe the three models of atomic structure---planetary, three-dimensional, and electron-cloud.

31. Define metals and nonmetals.

32. Compare and contrase metals and nonmetals.

33. Observe a demonstration using an electrohemical cell that provides evidence for the transfer of electric charge during a chemical reaction.

34. Perform an experiement that proves negative ions can be added to or removed from an KI (potassium-iodide) solution.

LEVEL OBJECTIVE:

THE STUDENT WILL DEMONSTRATE COMPREHENSION OF THE CLASSIFICATION AND PROPERTIES OF FAMILIES OF ELEMENTS AND WILL DISPLAY APPLICATION OF CHEMICAL CONCEPTS TO THE INVESTIGATION OF AN UNKNOWN SUBSTANCE IN THE FOLLOWING SUGGESTED ACTIVITIES.

I. Classifying Elements

Objective #1: The student will demonstrate comprehension of the basis on which elements are classified by examination of the properties and behavior of elements and their compounds. The following activities to be evaluated by teacher observation and/or tests are directed toward this objective.

Activities:

1. Group elements according to the ability of each element to gain or lose electrons.
2. Organize data about the elements in an attempt to construct his own periodic chart.
3. Group elements into families whose members behave similarly in chemical reactions.
4. Examine the following chemical families: Helium, Fluorine (Halogen), Oxygen, Nitrogen, Carbon, Boron, Beryllium, Lithium.
5. Recognize the characteristics of each chemical family.
6. Analyze Mendeleeff's method of grouping elements.
7. State the differences between Mendeleeff's method of grouping elements and the family method of grouping elements.
8. Examine a Periodic Table.
9. Identify the following characteristics on the Periodic Table: families, groups, color code, chemical symbols, atomic number, atomic weight, electron configuration.
10. Examine the "Mole" Concept.
11. Calculate the number of grams in one mole of chemical compounds.
12. Weigh a number of objects of different kinds and calculate the relative weights.
13. Illustrate the similarity of chemical reactions that occur within a family of elements by performing experiments.

14. Examine the conductivity of sodium chloride, hydrochloric acid, sodium hydroxide, methyl orange, table sugar, potassium bromide, barium chloride, and water by using a battery-operated conductivity indicator.

15. Describe the characteristics of acids, bases, and neutrals.

16. Classify compounds as either an acid, base, or neutral.

17. Test for acids and bases by using indicators such as red and blue litmus paper, methyl orange, phenolphthalein, and bromthymol blue.

18. Determine the pH (hydrogen concentration) of various solution by using pH (hydrion) paper.

19. Observe the formation of a salt by the combination of equal amounts of sodium hydroxide and hydrochloric acid.

20. Write the chemical equation for the chemical reaction of neutralization: $NaOH + HCl \quad NaCl + H_2O$

21. Explain the neutralization equation.

22. Observe both neutralization and precipitation as a result of the reaction between an acid and a base.

23. Perform an experiment that illustrates that elements belonging to the same family tend to have similar chemical properties.

24. Perform an experiement that develops the idea of balancing equations using conservation of matter.

25. Balance simple equations.

26. Conduct a comprehensive study of one unidentified compound (bluestone-copper sulfate).

27. Collect data about the unknown by conducting original research.

28. Organize a set of chemical principles from the study of bluestone which can be applied to an understanding of many chemical phenomena.

29. Analyze bluestone by performing the following: (1) making a bluestone solution, (2) evaporating bluestone solution, (3) observing crushed bluestone, (4) adding iron filings to bluestone solution, (5) adding barium chloride to bluestone solutin.

30. Test a solution of bluestone for the presence and behavior of irons.

31. Recognize that there is a relationship between the structure of bluestone and its color.

32. Perform an experiment that provides evidence that the hydration of bluestone involves an energy change.

33. Compare four salts (sodium chloride, copper sulfate, potassium sulfate, and sodium carbonate) by using the indicators red and blue litmus paper, methyl orange, bromthymol-blue, phenolphthalein and pH paper.

LEVEL OBJECTIVE:

THE STUDENT WILL DEMONSTRATE COMPREHENSION OF HOW MATTER IS MEASURED AND THE RELATIONSHIP BETWEEN MOTION AND ENERGY BY COMPLETEING THE FOLLOWING SUGGESTED ACTIVITIES.

I. Measuring Matter

Objective #1: The student will display application of concepts used in measuring matter by performing the following activities to be evaluated by teacher observation and/or tests.

Activities:

1. Explain the need for standard units of measurement.
2. Measure the length and area in metric units of a given object.
3. Discuss experimental error using a chart of measurement placed on board by teacher.
4. Measure the volume of a rectangular prism by finding length, width, and height in centimeters.
5. Find the volume of a rectangular prism by using displacement of water method.
6. Plot on a graph the volume of three solid objects by comparing the volume in cubic units to milliliters and cubic centimeters to milliliters.
7. Compare the mass and volume of water by plotting 5 trials of each on a graph.
8. State the relationship that exists between the mass and volume of water.
9. Observe incorrect use of a balance and diagnose the error.
10. Compare the mass and volume of liquids other than water (karo syrup and alcohol) by plotting them on a graph and find the densities.
11. Determine the density of various objects provided by the teacher.
12. Define specific gravity.
13. Find the specific gravity of objects provided by the teacher.

14. Prove knowledge of time by creating timing devices with the equipment provided.

15. Compare the size and shape with the of a falling object using folded sheets of paper.

16. Launch a ball in a grooved track by using a force mechanism.

17. Describe the natural condition of an object.

18. Use a timing device (not a clock or watch) to time an event.

19. Define speed and calculate the speed of a ball rolling down a track.

20. Compare the force needed to bend a spring and the speed of a steel ball on a groved track.

21. Construct a rubber-band force gauge.

22. Using a force gauge, weigh an object.

23. Explain the action of the rubber band when stretched by the addition of more force on the band.

24. Use a force gauge to measure frictional force.

25. Prove by experimentation that shape and area of surfaces in contrast, affect the amount of friction.

26. Compute the speed of a ball rolling in a grooved track, with time and distance known.

27. Compute the speed of a ball rolling in a grooved track, with time and distance unknown.

28. Find the acceleration of a ball rolling down a grooved track.

29. Mark on a strip of paper at equal time intervals.

30. Plot the constant acceleration of a ball rolling down a grooved track.

31. Using a meterstick and the marks on a strip of paper, measure distance and time intervals.

32. Define momentum.

33. Dfine velocity and compare it to speed.

34. Prove that momentum is conserved if a marble rolling on a track strikes a stationary marble.

35. Adjust an inclined track to a specified slope.

36. Measure the slope of an inclined track.

37. Prove that two objects with the same momentum and different masses have different energy.

38. Measure the length of a pendulum.

39. Release a pendulum at a specified distance from the rest position.

40. Prepare a chart which will prove that the length of the string of a pendulum determines the number of swings.

41. Compute the speed of the steel ball.

42. Compute the speed of the marble.

43. Find acceleration of the steel ball and marble.

44. Explain why the acceleration of the marble should be greater.

LEVEL OBJECTIVE:

THE STUDENT WILL DEMONSTRATE COMPREHENSION OF CONCEPTS OF TEMPERATURE AND HEAT MEASUREMENT, THE NATURE AND PROPERTIES OF LIGHT, AND THE CONVERTIBILITY OF ENERGY BY COMPLETING THE FOLLOWING SUGGESTED ACTIVITIES:

I. Heat Energy

Objective #1: The student will demonstrate applciation of basic principles used in measuring heat and temperature by performing the following suggested activities to be evaluated by teacher observation and/or tests.

Activities:

1. Measure the temperature of water in a beaker.
2. Divide a given linear scale into halves and quarter.
3. Calibrate the temperature on an alcohol thermometer.
4. Suggest a model that might explain the change in the volume as ice melts to form water.
5. Find the effect of salt, sugar, and alcohol on the temperature of ice.
6. By using dry ice, demonstrate the behavior of matter under conditions of low temperature.
7. Find the rise in temperature of water when friction causes and acceleration of water molecules.
8. Given a change in temperature and the amount of water calculate the amount of calories needed for change.
9. Compute the number of calories needed to change the temperature from one value to another for a specified mass of water.
10. Measure the heat needed to change one gram of ice to one gram of water.
11. Measure the heat required to change one gram of water at $100^{o}C$ to vapor at $100^{o}C$.
12. Control the measurement of a drop of liquid in glass tubing.
13. Explain why a water drop will rise in a flask when heat from the hand is added.
14. Support a thermometer, using a ring stand and clamp.

15. Compare the rate of hear loss using alcohol and water, evaporating from a cloth wrapped around a thermometer.

16. Demonstrate that heat flows from regions of high temperature to regions of low temperature.

17. Explain this fact in terms of behavior of molecules.

18. Find the temperature of two cups of water one of which is painted black.

19. Place the two cups equidistant from a light source.

II. Light Energy

Objective #2: The student will demonstrate comprehension of nature and properties of light by performing the following activities to be evaluated by teacher observation and/or tests.

Activities:

20. State the speed of light in miles per second.

21. View light through holes in a shoe box and explain why light beam cannot be seen from above.

22. Focus a flashlight beam on a mirror. Reflect it toward the ceiling and compare the reflected light to a ball bouncing against a wall.

23. List some properties of a mirror.

24. View a line reflected in a mirror and describe how light could consist of particles.

25. Place dots at specified points within a square. (example: place dots 1 cm from top and 2 cm from left side).

26. Locate an image by paralla.

27. Use a protractor to draw or measure an angle.

28. Describe the angle at which light will be reflected in a mirror and compare it to the angle at which it enters.

29. Line up four pins by looking through a plastic box full of water.

30. Draw lines through points and explain why line is not straight.

31. Sketch the reflected values in the ripple tank.

32. Compare the reflected waves of water with that of light.

33. Place a round metal lens and a prism in the ripple tank and sketch the waves created.

34. Define interference.

35. Sketch patterns of waves formed by the interference plate.

36. Reflect light off a wrinkled surface and a smooth one, record which one appears to be brighter.

37. Explain how a filter gives off certain colors.

38. Place a crystal on the loop of a flame tester.

39. Using the flame test, identify the positive ion in a crystal.

40. Explain where the color change gets the energy it needs.

41. Complete a circuit by connecting a milliammeter to it.

42. Read the current flowing in a circuit containing a milliammeter.

43. Explain why there is a flow of electron in a solar cell.

44. Identify the positive and negative terminals of a milliammeter.

45. Explain in terms of electrical energy, the effect of heating two different kinds of metal that are touching.

46. Create a circuit using two chemical and a milliammeter.

47. Explain where the electrical energy came from.

LEVEL OBJECTIVE:

THE STUDENT WILL APPLY KNOWLEDGE OF THE FORCES WHICH EFFECT THE EARTH TO GAIN AN UNDERSTNADING OF MAN"S PHYSICAL ENVIRONMENT BY COMPLETING THE FOLLOWING SUGGESTED ACTIVITIES MEASURED BY TEACHER OBSERVATION AND TESTS.

Objective #1: The student will display knowledge of methods measurement and observation by satisfactorily participating in the following activities measured by teacher observation and tests.

Activities:

1. Define and differentiate between the terms observation and interpretation.

2. Conduct an experiment in observation and interpretation using a variety of objects placed in boxes designed to test the importance of each sense.

3. Determine the mass of an object to the nearest tenth of a gram on a triple-beam balance.

4. Determine the volume in cubic centimeters of a regular-shaped and an irregular-shaped object.

5. Calculate the densities of a solid and a liquid.

Objective #2: The student will increase in comprehension of patterns of change in relation to the earth by satisfactorily completing the following activities measured by teacher observation and/or tests.

Activities:

6. List six examples of how the earth is changing, including changes from weather, geology, volcanic activity, and earth motions.

7. Conduct an experiment to change a simple material in as many ways as possible, and compare the artificial changes to natural events.

8. Define interface, and list four examples of natural and artificial interfaces.

9. Conduct an experiment to test the effects of change on limeston fragments, by shaking in a water filled container.

10. Define the terms variable and rate.

11. Determine the effects of the variables, (rate, time, amount) in the experiment on erosion of rock fragments.

12. Predict a pattern of change in sunspot activity by completing a graph of sunspot numbers for the years 1906-1965.

13. Explain the importance of observations and probability in predicting a pattern of change.

14. List three examples of how time and space together describe change in earht events.

15. Conduct an experiment to investigate a pattern of change in earthquakes, by plotting earthquakes on a wall map.

16. Define the terms focus, epicenter, and intensity in their application to earthquakes.

17. Conduct an experiment to investigate the pattern of change in the sun's path, by plotting the sun's position for several hours on a plastic hemisphere for each seasons.

Objective #3: The student will increase in comprehension of change as it relates to temperature by satisfactorily completing the following activities to be measured by teacher observation and/or tests.

Activities:

18. Read a centigrade thermometer.

19. Define and plot isotherms.

20. Conduct an experiment to measure a temperature field using plastic sheets with separators and plotting isotherms.

21. Determine the factors, (height, heat sources, drafts) that caused variations on a temperature field.

Objective $4: The student will apply knowledge of acceleration, the motion of falling bodies to gain an umlers founding of gravity by satisfactorily completing the following activities to be measured by teacher observation and/or tests.

Activities:

22. Conduct an experiment to show steady rate, speeding-up, and irregular motion by the use of a battery operated timer and tape.

23. Measure the behavior of a falling object by constructing a graph of tape segments resulting from a free-falling weight.

24. Determine the speed of a falling object by measurement of the distance and time of the fall.

25. Explain the difference between velocity and speed.

26. Define the terms acceleration and force.

27. List one application for each of Newton's three laws of motion:

    Inertia, Acceleration, and Action-reaction

28. Explain how gravitational attraction is determined by the masses and distance between two objects.

29. List illustrations which indicate that gravity is universal.

30. Explain the difference between mass and weight.

31. Explain how gravitational readings can be used to determine differences in the earth's crust and locate mineral and oil deposits.

Objective #5: The student will apply knowledge of magnetic forces to gain an understanding fo the effects upon the earth by satisfactorily completing the following activities to be measured by teacher observation and/or tests.

Activities:

32. Conduct an experiment with iron filings to determine the field of a spherical magnet.

33. Explain how a freely-suspended magnet acts as a compass.

34. Locate on a map the magnetic and geographic north poles.

35. Define magnetic declination and explain how it differs in different parts of the United States.

36. Measure magnetic inclination with a dipping needle and explain how it changes with latitude.

37. Explain the cause and effects of auroras, magnetic storms, and the Van Allen belts.

Objective #6: The student will increase in comprehension of concepts of energy, force and work by satisfactorily completing the following activities to be measured by teacher observation and/or tests.

Activities:

38. Define energy, force, and work.

39. List one example for each of the following forms of energy:

mechanical	chemical
thermal	electrical
radiant	nuclear

40. List three examples for each class of energy, potential and kinetic.

41. Conduct an experiment to demonstrate absorption and transfer of energy using thermometers, aluminum cans and a lamp.

42. Conduct an experiment to demonstrate energy flow using an aluminum transer bar and calorimeters containing water at different temperatures.

43. Explain how heat energy is transfered by conduction, convection, and radiation.

44. List one example from nature to illustrate an energy source and an energy sink.

45. Explain the law of conservation of energy.

46. Define and compare temperature and heat.

47. Measure the number of calories produced by heating a given mass of water over a definite length of time.

48. Conduct an experiment to measure the effects of melting (ice) and boiling on heat input and temperature change.

49. Explain the energy changes involved in a change of state.

OPTIONAL ACTIVITIES:

1. List three examples or natural events that illustrate the earth is spherical.

2. Design a reference system to locate points on a shpere using a plastic ball and markers.

3. Define longitude and latitude, and identify three major cities on a map or globe from their coordinates.

4. Locate on a map or globe the Prime meridian.

5. conduct an experiment to measure the angle of the suns rays at noon.

6. Calculate the circumference on a model of the globe using sticks with suction cups with one positioned to duplicate the noon angle of the sun and the second one positioned to cast no shadow. Use the following proportion to determine the circumference:

$$\frac{\text{Distance around globe}}{\text{distance between sticks}} = \frac{\text{Angle of full circle } (360^0)}{\text{angle of suns rays at noon}}$$

7. Apply the model of the earth's circumference to determine the actual circumferences of the earth, by substituting the distance in miles for the distance between sticks.

LEVEL OBJECTIVE:

THE STUDENT WILL INCREASE COMPREHENSION OF THE INTLUONCES WHICH VARIOUS FACTORS HAVE ON THE CONDITION AND CHANGES IN THE ATMOSPHERE BY PART-ICIPATION IN THE EVALUATION WILL BE MADE BY GROUP DISCUSSION AND/OR TEACHER-MADE TESTS.

I. Energy and Air Motions

Objective #1: The student will increase comprehension of the effects of radiant energy on the earth's temperature levels by successfully engaging in the following suggested activities.

Activities:

1. Conduct an experiment to observe how absorption of radiant energy is determined by the inverse square of the distance from the energy source. Use a light source, blackened cans, and thermometers to determine the temperature values.

2. Describe the factors that determine the average temperature of a planet, include distance from sun, solor output, and seasonal change.

3. Define insulation and explain how the atmosphere, cloud cover, and surface of the earth, determine the amount absorbed or reflected.

4. Describe the effects of short-wave and long-wave radiation on the temperature of the atmosphere.

5. Describe the temperature ranges that occur in the troposphere, stratosphere, and mesosphere.

Objective #2: The student will increase comprehension of the effects of air on the climate by successfully engaging in the following activities.

Activities:

6. Describe the effect of the earth's latitude on insulation.

7. Conduct an experiment to show the presence of convection currents in a liquid.

8. Define fluid, and describe the effects of increasing and decreasing temperatures on it's density.

9. Define isobar and isotherm and locate and identify each on a weather map.

10. Describe the effects of convection on movement of air along the surface of the earth.

11. Describe the conditions that cause turbulence in a cumulus cloud.

12. Define a cyclone and identify from sattelite photographs.

13. Describe the location and direction of the trade winds, doldrums, polar easterlies, prevailing westerlies, and Intertropical Convergence Zone on a map of the earth's general circulation.

14. Demonstrate the coriolis effect on a spinning globe with water.

15. Explain how the coriolis effect causes the deflection of wind in the Northern and Sourthern Hemispheres.

16. Conduct an experiment to determine the differences in absorption of radiant energy for land and water areas, using light source, thermometers, and containers of soil and water.

17. Explain how seasonal changes cause monsoons in India and S.E. Asia.

18. Locate on a map the pressure belts of the world. Include the polar lows, and the sub-tropical highs.

II. Water in the Air

Objective #3: The student will increase comprehension of the effects of water in the atmosphere by successfully engaging in the following activities.

Activities:

19. Describe the water cycle including the three stages: evaporation, condensation, precipitation.

20. Conduct an experiment to determine the factors that influence the rate of evaporation using a single beam balance and sponges soaked in water at different temperature.

21. Define vapor pressure and explain the effects of temperature on its value.

22. Define dew point and explain how frost and dew occurs.

23. Measure the dew point with a wet bulb thermometer.

24. Determine the wet and dry bulb temperatures and find the humidity from a prepared chart.

25. Explain how cloud formation and precipitation occurs on the windward and leeward surfaces of a mountain range.

26. Explain how fog occurs.

27. Explain how converging and diverging winds effect the atmosphere.

28. Identify from pictures and from nature the following types of clouds:
Cumulus, Cirrostratus, Cirrus, Stratus, Altocumulus, Cumulonimbus

29. Describe the conditions that cause the formation of stratiform and cumuliform type clouds.

30. Explain how the following types of precipitation are formed: rain, hail, snow and sleet.

Objective #4: The student will increase in comprehension of the effects of atmospheric pressure climate and weather by engaging in the following activities.

Activities:

31. Conduct an investigation to determine the relationships between the various factors that influence weather by collecting weather maps for a week and comparing:
wind direction to pressure change

cloudiness to pressure change

precipitation to pressure change

32. Describe the characteristics of air masses and the locations over which they may form.

33. Describe the conditions that cause an air mass to be stable or unstable.

34. Construct a model using fluids of different densities to represent the movement of a cold front.

35. Explain how cyclones develop along a front.

36. Describe the weather changes that occur with the passage of the following fronts:

warm cold stationary occluded

37. Describe the formation and weather conditions of a hurricane.

38. Measure the dew point with a sling psychrometer.

39. Explain how the dew point determines the altitude of clouds.

40. Identify on a U.S. weather map highs, lows, air masses, and fronts.

III. Climate and Weather

Objective #5: The student will apply knowledge of atmospheric conditions, location, and physical features of the earth to a study of climate by engaging in the following activities.

Activities:

41. Predict the climate given a map of an imaginary continent.

42. Explain the temperature patterns that occur in the tropical, temperate and polar latitudes.

43. Explain how the length of daylight is related to latitude and season.

44. Explain why June 21st is the longest day and September 21st is the shortest day in our latitude.

45. Explain how the amount of water vapor varies with latitude.

46. Explain how oceans and continents influence climate.

47. Explain how the prevailing winds influence climate.

48. Show on a graph of precipitation vs. latitude, the pattern of rainfall surplus and deficit for a continent.

49. Explain how mountains modify the circulation patterns of the atmosphere.

50. Identify the major climatic regions, the temperature and moisture conditions for each regions, and the zones of converging and diverging air masses for an imaginary continent.

51. Read a climate graph and determine the rainfall and temperatures for each month.

52. Match pictures of climatic regions with the climate graph for that region.

LEVEL OJBECTIVE:

THE STUDENT WILL INCREASE IN COMPRHENSION OF THE PHYSICAL NATURE OF THE EARTH BY COMPLETING THE FOLLOWING SUGGESTED ACTIVITIES MEASURED BY TEACHER-MADE TESTS.

I. Earth Materials

Objective #1: The student will display knowledge of the structure and appearance of rocks and minerals by satisfactorily participating in the following suggested activities measured by teacher-made tests

Activities:

1. Identify and differentiate the major parts of the earth, namely the lithosphere, atmosphere and hydrosphere.
2. Diagram and label the rock cycle.
3. Identify rock samples as igneous, metamorphic or sedimentary.
4. Make a list of descriptive terms to identify a rock sample supplied by the teacher (granity).
5. Separate crushed particles of granite so that each separate pile has like characteristics.
6. Examine and note the characteristics of some common minerals.
7. Summarize the particles and their characteristics which are found in an atom.
8. Draw the structure of the first ten elements showing the basic atomic particles in each.
9. Make a list of the ways that minerals differ from one another physically.
10. Construct models of some simple compounds and minerals using styrofoam.
11. Construct models of oxygen and silicon dioxide.
12. Match diagrams which illustrate atomic structure with actual samples of olivine, hornblend, mica, and quartz.
13. Select from a list of elements the two most abundant elements in the atmosphere, lithosphere and hydrosphere.
14. Investigate several forms of rocks, arrange them by similar characteristics, and comment of the possible formation of each.

15. Define the metamorphic process.

16. Investigate several forms of igneous rock and comment on the formation and mineral content of each. (use charts).

17. Investigate the formation of salol crystals under several different environments.

18. Produce a diagram of the Rock Cycle.

19. Investigate several mountain ranges in stereo atlases and note the vegation and cultural features that may give an indication of climate. Identify possible sites where specific rocks may be found.

II. The Interior of the Earth

Objective #2: The student will display knowledge of theory and known facts about the structure and composition of the earth's interior by satisfactorily completing the following activities measured by teacher-made tests.

Activities:

20. Investigate two spheres supplied by the teacher to determine densities, rotational abilities, and mass distribution.

21. Cite examples of how the earth's mass or density is distrubuted from the crust to the core.

22. Define a compressional-primary (p) wave and a sheer secondary (s) wave.

23. Locate the epicenter of an earthquake given the S and F wave arrival times at several recording stations.

24. List and describe the various layers of the earth's interior.

25. List the types of material found in the earth's interior.

26. Cite evidence for the earth's interior being liquid.

27. Cite evidence for the earth's interior being solid.

28. Describe the Dynamo Theory.

29. Describe the Convention Theory.

30. Describe the Continental Drift Theory.

III. Time and Its Measurement

Objective #3: The student will increase in comprehension of methods of measuring lony periods of time by satisfactorily participating in the following activities measured by teacher-made tests.

Activities:

31. Define time.

32. Differentiate between relative time and measured time.

33. Investigate a tree cross section and determine its age.

34. Investigate ½ life by placing markers in a box, shaking, and then removing those markers which point to a predetermined side of the box. Plot the decayed particles (markers removed) against each shake (half-life).

35. Define radioactivity and ½ life.

36. Summarize how carbon 14 is important in dating old materials.

37. Diagram to scale the "periods" which make up the geologic record (using adding machine tape).

IV. Record in the Rocks

Objective #4: The student will increase in comprehension of means by which geological time can be traced by satisfactorily completing activities measured by teacher-made tests.

Activities:

38. List the physical properties of a rock sample.

39. Define and diagram layering, cross beds, and ripple marks.

40. Determine the position of an ancient stream bed, given positions of ripple marks, cross bedded sands, and bedrock on a present day model.

41. Investigate rock fragments and fossils to determine the geologic history of outcroppings in a given area.

42. Construct a model to illustrate domes, faulting, synclines, and anticlines.

43. Investigate a geologic model to determine the age of layers, direction and cause of folding, and cause of faults.

44. Define: "unconformities."

45. List several ways by which rock evidence can given indication of an ancient climate.

46. Describe several differences between a living and non-living object.

47. Define photosynthesis and carbohydrate.

48. Complete the photosynthesis equation...H_2O & CO_2---

49. List the basic steps in the carbon cycle.

50. Define paleontologist and microfossil.

51. Interpret fossilized footprint models as to size and nature of the animal which produced them.

52. Define mold and cast.

53. List the most favorable environmental conditions for the production of a fossil.

54. Prepare plaster molds and casts of familiar objects.

55. Define guide or index fossil.

56. Research (50-100 words) Darwins meaning of variation and natural selection.

57. Investigate two slabs of rock models which contain fossils and determine what evolutionary trends might have occurred.

58. Trace the evolution of one animal with a written report (100-200 words).

59. List several animals which began their existance in the Paleozoic Era.

60. List several animals which began their existance in the Mesozoic Era.

61. List several animals which began their existance in the Cenozoic Era.

LEVEL OBJECTIVE:

THE STUDENT WILL INCREASE IN COMPREHENSION OF THE OCEAN, ITS CHEMICAL AND PHYSICAL PROPERTIES, AND ITS REALTIONSHIPS TO THE REST OF THE EARTH BY COMPLETING THE FOLLOWING SUGGESTED ACTIVITIES AS MEASURED BY TEACHER MADE TESTS.

Objective #1: The student will display knowledge of ocean salinity and other factors relating to it by satisfactorily completing as measured by teacher made tests.

Activities:

1. Explain how the water cycle makes the ocean salty.
2. Define salinity and state the average value for saltwater.
3. Explain the importance of rivers' flow to salinity.
4. List the six important ions that are found in seawater.
5. Explain how plankton effect the amounts of dissolved substances.
6. Explain the importance of the exchange of salts between the atmosphere and the ocean.
7. List the two important gases that are dissolved in the ocean and explain their importance in maintaining ife on land.
8. Explain how the salinity of the oceans is related to latitude and precipitation

Objective #2: The student will increase in comprehension of the relationship of the ocean to atmospheric temperature by satisfactorily completing the following suggested activities measured by teacher made tests.

Activities:

9. Explain why the ocean is important in heating the atmosphere.
10. Conduct a simple demonstration using different liquids to show that energy is needed for evaporation.

Objective #3: The student will increase in comprehension of the motions of a body of water by satisfactorily completing the following activities measured by teacher made tests.

11. Explain the relationship between wind and the size of waves.

12. Describe or diagram the characteristics of a wave, include wave length and height, crest, and trough.

13. Define wave speed and period and calculate the wave speed using the formula:

$$\text{Wave speed} = \frac{\text{wavelength}}{\text{period}}$$

14. Demonstrate the characteristics of a wave by jiggling a long rope, with a knot in the middle, and fastened at on end.

15. Describe the orbital motion of water particles at the surface and below the surface of a wave.

16. Describe the speed of long and short waves in deep and shallow water.

17. Describe the general pattersn of ocean currents in the Northern and Southern Hemispheres.

18. Explain how ocean currents are effected by the rotation of the earth and by prevailing winds.

19. Define upwelling and describe its importance to marine life.

Objective #4: The student will apply knowledge of ocean density to determine the effects of this property upon the ocean by satisfactorily completing the following activities measured by teacher made tests.

Activities:

20. Explain how the density of seawater depends upon temperature and salinity.

21. Conduct an experiment to show how density differences cause circulation deep in the oceans. Use the density current apparatus and salt solutions of different densities.

22. Conduct an experiment to measure the effect of density on ocean ciruclation. Use a container of water to represent a model of the ocean and thermometers equally spaced along the bottom to measure temperature changes caused by melting ice.

23. List three methods by which ocean currents may be measured.

24. Describe the effects of the balance of carbon dioxide in the oceans upon climatic change.

Objective #5: The student will apply knowledge of oceans characteristics for a study of ocean sediments by satisfactorily completing the following activities measured by teacher made tests.

Activities:

25. Conduct an experiment to determine the rate of deposition for sediments by dropping and timing the fall for different sediment sizes in a column filled with water.

26. Conduct an experiment to determine how mixed sediment become arranged in a deposit by dropping a handful of randomly mixed sediments in a column filled with water.

27. Describe the formation of a delta.

28. List the factors that determine the rate of settling for a particle.

29. Explain how rivers, weathering and erosion, winds, and glaciers contribute to ocean deposits.

30. Describe the characteristics of the continental shelf, slope, and rise.

31. Explain how submarine canyons may have been formed in the continental slope and shelves.

32. Conduct an experiment to determine how density currents may carry coarse sediments by pouring a slurry of soil and tap water into a slopping column of water, and describing the characteristics of the deposits.

33. Explain hwo diatoms and foraminifera cause ocean deposits.

34. Describe how change in glacial ice amount for fluctuations in sea level, and growth of deltas.

35. Describe the factors that cause movements of the shoreline; include calcium carbonate, precipitation, change in sea level, and growth of deltas.

36. Explain how the sediments on the continental shelves and those in the ocean basi: indicate that the margins of the continents are sinking.

37. Describe how the voyage of the H.M.S. Challenger contributed to oceanography.

OUTLINES

Level IV E.S.C.P.

Astronomy

Chapter 4 Earth Motions

Chapter 22 Moon, A Natural Satellite

Chapter 23 The Solar System

Chapter 24 Stars as Other Suns (optional)

Chapter 25 Stellar Evolution and Galaxies (optional)

Chapter 26 The Universe and its Origin

LEVEL OBJECTIVE:

THE STUDENT WILL INCREASE IN COMPREHENSION OF THE RELATIONSHIP OF THE EARTH TO THE SOLAR SYSTEM AND THE UNIVERSE BY COMPLETING THE FOLLOWING SUGGESTED ACTIVITIES MEASURED BY CLASS DECISIONS AND TEACHER-MADE TESTS.

Objective #1: The student will increase in comprehension of the paths of celestial bodies by satisfactorily participating in the following suggested activities measured by teacher observation and tests.

Activities:

1. Plot on transparent globes the path of stars over various periods of time.

2. Draw the shape of the celestrail sphere and demonstrate how this shpere can be used as a frame of reference.

Objective #2: The student will increase in comprehension of the earth's motions by satisfactorily participating in the following suggested activities measured by teacher observation and tests.

Activities:

3. List all the motions that an object has in relationship to the rest of the universe.

4. List and describe three events or examples which prove the earth rotates.

5. Demonstrate with globe and light source the various seasons.

6. Diagram the various seasons showing the positions of the earth and sun.

7. Plot a transparent shpere or diagram the sun's path over various periods of time.

8. Diagram the earth's position and tilt in relationship to the sun during the four seasons of the year.

Objective #3: The student will increase in comprehension of the earth's reference points as related to time, climate, and seasons by satisfactorily completing the following suggested activities measured by teahcer observation and tests.

Activities:

9. Label on an earth diagram the following points; North and South Poles; The Artic and Antarctic Circles; the Tropic of Cancer and Capricorn, and the Equator.

10. Make a circle drawing of the earth and with a compass draw to scale the tropic lines, the equator, and the poles.

11. Locate the position on the earth where the sun is directly overhead at noon for March 21, June 21, September 21, and Dec. 21.

12. Describe how exact noon at nay location is determined.

13. Determine the time at several locations on the earth's surface given the correct time at one spot.

14. List the primary lines of latitude and longitude.

15. Define latitude, longitude.

16. Define International Dateline and locate on a map.

17. Calculate the time and day as one travels west across the I.D.L. (given the time and day on the east side).

18. List the continental time zones in the U.S.

Objective #4: The student will apply knowledge of oceans tides by satisfactorily participating in the following suggested activitites measured by teacher observation and tests.

Activities:

19. Accumulate weather reports over a period of several days and plot the times of high and low tides.

20. Predict when the next high tide will occur 9given time of last).

21. Explain the reason for two high tides per day in terms of earth and moon gravitational forces.

Objective #5: The student will increase in comprehension of the moon by satisfactorily participating in the following suggested activities measured by teacher observation and tests.

Activities:

22. Examine pictures or models of the moon's physical features Craters, Maria, Rays, Mountains, Rilles and Ridges.

23. List the moon's physical features in order of their theoretical historical appearance.

24. Summarize the characteristics of the important craters on the earth's surface. List several examples of how the moons surface feature have evolved differently than features on the earth's surface.

25. Define Barycenter.

26. Plot the moon's motion on a circular graph over a period of time given distance from earth and celestual longitude.

27. Define sideral month and synodic month.

28. Diagram and label the various phases of the moon.

29. Obtain several new clippings describing the latest investigations on the moon.

30. List and describe at least three theories concerning the moon's origin.

Objective #6: The student will increase in comprehension of the position, and motions of the planets and other solar bodies by satisfactorily participating in the following suggested activities measured by teacher observation and tests.

Activities:

31. Plot the motion of a planet given a series of pictures representing several months time.

32. Define the Ptotemy Theory.

33. Investigate the positions and properly sequence the sun, earth and planet X (mars) given pictures of plant X's phases, a light source and styrofoam ball.

34. Define the Copernican Theory for the Solar System.

35. Make a scale model of the solar system using adding machine tape.

36. List the mojor planets and with each, summarize its major characteristics.

37. List the major planets and with each, summarize its major characteristics.

38. Describe asteroid and meterorids and locate where they may be found.

39. Describe the parts of a comet and its path through the solar system.

40. Research and describe at least 3 theories which explain the origin of the solar system.

Additional (optional) Activities:

1. Define luminousity and magnitude.

2. List several ways in which stars differ.

3. Define Light years.

4. List several ways that the physical character of a star are determined.

5. Heat a wire in a bunsen burner and record the color changes as the wire becomes hotter.

6. Match a list of star colors with a list of star temperatures.

7. Define spectral lines.

8. Compare the spectra of the sun, light bulbs, and various gases with a spectroscope.

9. Plot luminousity vs temperature for the 20 brightest stars.

10. Measure the diameter of the sun by using a pin-hole focus, a blank card and a meter sitck. Calculate by proportions.

11. Trace the evolutionary stages in the development of a yound star through old age until it finally dies. (comment about color and temperature of each stage).

12. Define and H.R. diagram.

13. Indicate how and H.R. diagram of star clusters confirms the theoritical picture of how stars evolve. Separate by visual characteristics the several known types of galaxies given pictures of each type.

14. Describe the milky way, size, shape, rotation and the suns location in it.

15. Define galaxy.

16. Place the terms earth, sun, solar system, milky way, galaxy, clusters in increasing size order. (rearranged)

17. (optional) Label in a diagram, wave lengths, amplitide, wave crest, wave trough.

18. Define Dappler Effect.

19. Describe the Red Shift of stars and how this is used for evidence of an expanding universe.

20. Plot the velocity of galaxies against distance (given the date).

21. Define Huble's Law.

22. Research and describe at least two theories on the origin of the universe.

LEVEL OBJECTIVE:

THE STUDENT WILL DEMONSTRATE COMPREHENSION OF THE NATURE OF MATTER IN TERMS OF ITS QUANTIFICATION BY COMPLETING THE FOLLOWING SUGGESTED ACTIVITIES:

I. Investigating Matter: Destructive Distillation of Wood

Objective #1: The student will display knowledge of the value of experimentation to investigating matter. In addition, he will demonstrate application of laboratory techniques used in the destructive distillation of wood by performing the following suggested activities to be evaluated by teacher observation.

Activities:

1. Assemble and use equipment which will be used in distructive distillation of wood.

2. Maintain a notebook for recording data and drawing conclusions from data.

3. Predict what will happen when wood splints are heated without burning them.

4. List two properties of matter.

II. Measuring Matter

Objective #2: The student will demonstrate application of the concepts of mass and volume through experimentation directed to support the law of conservation of mass. The following activities designed to achieve this objective will be evaluated by teacher observation and/or tests.

5. Measure the volume of a rectangular object using the English and Metirc systems.

6. Measure a given volume of a liquid with a graduated cylinder.

7. Measure the volume of an irregular object by displacement of water.

8. Define what is meant by mass of an object.

9. Find the mass of several objects using an equal-arm balance provided by the teacher.

10. Find the mass of several objects to .01 of a bead and calibrate the balance.

11. Plot a graph showing the relationship between mass in grams and mass in beads.

12. Prove by experimentation that no change in mass results as salt dissolves in water.

13. Show by experimentation what will happen to the mass when ice melts.

14. Predict what will happen to the total mass when two liquids form a solid.

15. Prove that a physical change in matter does not change the total mass of matter.

16. Prove that the mass of a gas remains the same as the mass of the material that forms it.

17. List evidence for the conservation of mass.

LEVEL OBJECTIVE:

THE STUDENT WILL INCREASE HIS COMPREHENSION OF THE NATURE OF MATTER BY INVESTIGATING THROUGH EXPERIMENTATION CHARACTERISTIC PROPERTIES OF MATTER IN THE FOLLOWING SUGGESTED ACTIVITIES.

I. Characteristic Properties of Matter

Objective #1: The student will demonstrate comprehension of the nature of characteristic properties of matter and their usefulness in separating mixtures by performing the following suggested activities to be evaluated by teacher observation and/or tests.

Activities:

1. Explain the physical significance of density by giving analogous relationships.
2. Measure the mass and volume of a given solid object using direct measurement in the metric system and the displacement of water.
3. Calculate the density of a given solid in metric units and beads.
4. Specify degrees of precision with which volume by displacement and measurement with a ruler can be obtained.
5. Determine the difference in two liquids by finding the densities.
6. Determine the density of a gas and generalize from the data by recording the limits for solids, liquids and gases.
7. Explain what thermal expansion is and the different rates of solids, liquids and gases.
8. Compare the elasticity of two solid wires if the length and diameter are the same.
9. Compare the elasticity of two gases using the plastic syringe.
10. Distinguish between two liquids by finding their freezing points.
11. Recognize that freezing point is not bases on quanity of material buy on characteristic properties.
12. Distinguish between two crystals by finding their melting points.

13. Recognize that melting point is not based on quanity of material but on characteristic properties.

14. Discriminate between three different liquids by finding their boiling points.

II. Solubility

Objective #2: The student will demonstrate application of the basic concepts of solubility by performing the following suggested activities to be evaluated by teacher observation and/or tests.

Activities:

15. Prove by performing solubility tests of sodium chloride and sodium nitrate that solubility of substances is a tool for identifying matter.

16. Describe that effect temperature hason solubility.

17. Show by experimentation that solubility of substances in another liquid (alcohol) also is a characteristic property.

18. Explain how oil of vitriol is formed.

19. Distinguish between two gases by testing with lime water, flammability test and by glowing and burining splints.

20. Show the difference between hydrogen and carbon dioxide by using their characteristic properties.

21. Prove that water will effect certain gases by disolving the gas into water.

22. Compare the effects of tmeperature on solubility of ammonia gas.

23. Describe some properties of products in distillation of wood by using density, melting and boiling point, solubility flamability, and reaction of gas to lime water test.

LEVEL OBJECTIVE:

THE STUDENT WILL DEMONSTRATE COMPREHENSION OF THE NATURE OF PURE SUBSTANCE AND THE DISTINCTION BETWEEN ELEMENTS AND COMPOUNDS THROUGH ANALYSIS OF HIS EXPERIMENTATION IN THE FOLLOWING SUGGESTED ACTIVITIES.

I. Separating Substances

Objective #1: The student will demonstrate application of characteristic properties to the separation of substances. In addition, he will develop through analysis of his experimentation an operational definition of a pure substance by performing the following suggested activities to be evaluated by teacher observation and/or tests.

Activities:

1. Boil away a liquid mixture noting time and termperature.
2. Produce a time-temperature graph of a liquid mixture as it is heated.
3. Interpret the time-temperature curve to determine how many different substances are in the mixture.
4. Separate a liquid mixture by fractional distillation.
5. Relate the process of fractional distillation to the study of petroleum.
6. Demonstrate the technique of filtering.
7. Separate a mixture of two solids.
8. Present a lab write-up using a flow chart.
9. Interpret solubility curves.
10. Separate dissolved substances by fractional crystalization.
11. Recognize that crystal shape is a characteristic property.
12. Investigate a substance (ink) with the techniques of filtration and fractional distillation.
13. Use paper chromatography as a tool for separation of substances.
14. Recognize that the properties of a mixture are a compromise between the properties of its components.

15. Recognize that the gases have low boiling points.

16. List a wide range of experimental tools used to separate gases.

17. Solve lab situation problems from written descriptions of gases at low temperatures.

18. Recognize the characteristics of a mixture and pure substance.

19. Distinguish between a compound and a separated mixture.

20. Set up electrolysis equipment.
Use the electrolysis procedure to decompose water and calculate the volume ratio of hydrogen to oxygen. Calculate the mass ratio of oxygen to hydrogen from decomposition data.

21. Recognize the 2:1 volume ratio of hydrogen to oxygen in water.

22. Recognize the results of mixing hydrogen and oxygen in ratios other than 2:1 and igniting the mixture.

23. Recognize that compounds are made in fixed mass ratios.

24. Recognize the importance of law of Constant Proportions.

25. Set up apparatus for heating in crucibles. Heat copper and describe the changes which take place.

26. Recognize a complete reaction by massing the products.

27. Demonstrate how to remove copper from its compounds through the following experiment: heat copper oxide and carbon and describe the changes which take place.

28. Recognize many substances cannot be broken down chemically, and that over 100 such substances exist.

29. Recognize that new operations may decompose supposed "elements."

30. Demonstrate that some elements impart characteristic colors to a flame.

31. Demonstrate line spectra.

32. Identify certain elements from their line spectra.

33. Use the method of Spectral Analysis to identify small amounts of elements and elements in mixtures and compounds.

LEVEL OBJECTIVE:

THE STUDENT WILL DEMONSTRATE COMPREHENSION OF THE NATURE OF MATTER BY DEVELOPING AN ATOMIC MODEL BASED ON HIS OWN EXPERIMENTATION IN THE FOLLOWING SUGGESTED ACTIVITIES.

I. Investigating Radioactivity

Objective #1: The student will demonstrate comprehension of the nature of matter in terms of developing a concept of the atom through investigation of radioactivity by performing the following activities to be evaluated by teacher observation and/or tests.

Activities:

1. Relate the effect of a radioactive substance on a photographic plate and on a geiger counter.
2. Operate a geiger counter and identify the parts.
3. Demonstrate with a geiger counter the effect of increasing distance between the counter and the radioactive source.
4. Identify some pioneers in the field of radioactivity.
5. Give an operational definition for a radioactive substance.
6. List the differences between a radioctive substance and a non-radioctive substance.
7. Differentiate between decomposition and disintegration.
8. Set up a cloud chamber.
9. Demonstrate the effect of a radioctive source in a cloud chamber.
10. List experimental evidence that leads to the idea that matter is made up of small particles.

II. Building an Atomic Model of Matter

Objective #2: The student will demonstrate comprehension of the atomic model of matter by performing the following activities to be evaluated by teacher observation and/or tests.

Activities:

11. Devise a "model" by making a list of properties for a substance he cannot see.

12. List the characteristic of properties of a man-made model (Black Box).

13. Relate that elements have characteristic properties.

14. Give examples of elements which form compounds.

15. List methods by which compounds may be broken into individual elements.

16. Assemble models with chemical formula given.

17. Disassemble atomic models and mass individual "elements" to determine the mass ratios in the models.

18. Compare the mass ratios in several similar models with the Law of Constant Proportions.

19. Translate given mass ratios into the form of x per 100 grams.

20. Predict some occurances using the atomic model of matter, given problems.

21. Investigate the mass ratios in two different compounds of copper.

22. Define and list examples for the Law of Multiple Proportions.

23. Diagram demonstrate or describe why, in the atomic model, molecule is a good term for use with gases, but clusters of molecules is more appropriate for liquids and solids.

24. Differentiate between theories, models, principles, and laws of science.

25. Devise an atomic model which amounts for the radioactivity process.

26. Relate the effect of a radioactive substance on a photographic plate and on a geiger counter.

27. Identify some pioneers in the field of radioactivity. Give lists of such pioneers and contributions match the person with a contribution (or some such thing).

28. Give an operational definition for a radioactive substance.

29. Differentiate between decomposition and disintegration.

30. Demonstrate the effect of a radioactive source in a cloud chamber.

31. List experimental evidence that leads to the idea that matter is made up of small particles.

32. Select a given number of elements from among those studied and summarize their characteristic properties.

33. Give examples of elements which form compounds.

34. List methods by which compounds may be broken into individual elements.